High Coherence Quantum Annealing and Fast, High-Fidelity Flux Qubit Readout

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***Abstract*— Quantum annealing is an interesting candidate for providing a new computing capability for a wide variety of combinatorial optimization problems. We have implemented quantum annealing-capable flux qubits built using MIT Lincoln Laboratory's capacitively-shunted flux qubit fabrication process. These qubits take advantage of lower persistent currents to achieve lower noise sensitivity and increase quantum coherence. Qubits with persistent currents in the nA range present unique challenges for readout, and previous methods using rf-SQUID tunable resonators were too slow for annealing applications. We report on the theory and experimental results of a persistent current readout scheme using quantum flux parametrons as a current amplifier that provides fast, high-fidelity readout of the flux qubit state.**

***Keywords (Index Terms)* — Quantum annealing, quantum computing, qubit, coherence, readout.**

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